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FORMERLY

AMERICAN GAS LIGHT JOURNAL

VOL. CXII., No. 22
WHOLE No. 3247

NEW YORK, SATURDAY, MAY 29, 1920

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INDEX TO CONTENTS, PAGE 425 ADVERTISERS' INDEX, PAGE 24

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Extreme Gravity of Gas Companies' Situation Impressed on Those in Attendance at Emergency Conference

Philip J. Gadsden Outlines Program of Emergency Committee for Immediate and Permanent Relief—Constructive Measures Already Adopted and Activities Started

With oil and lack of elasticity in rate systems the aggravating causes, the gas companies of this country are actually facing a grave situation. After almost a century of living up to the tradition of "Keeping the holder up," the coming winter looms up ominously as a test which not one or two small companies may fail to meet, but in which the supplies of gas of companies up to now deemed strong, almost impregnable may fail and be shut off.

There was no attempt at concealment of this fact at the Emergency Conference of the American Gas Association held in the Hotel Pennsylvania, New York City, May 26.

With an attendance as truly representative of the entire industry almost as large and as truly representative as an annual convention, the conference which brought even F. S. Wade, superintendent of the Coast Counties Gas Company, from as far a distance as Los Angeles, Cal., was not what might be termed a gathering of merrymakers.

The atmosphere was surcharged with gravity. Veterans of the industry, whose whole lives had been spent in public service, sat tense with anxiety and expectancy.

They knew their own situations best. It required no conference to tell this or that hitherto successful executive that his company's back was literally against the wall. Conditions that the best of management could not overcome, for they are beyond its control have brought them to a situation wherein unless immediate solution comes we may expect gas company after gas company go toppling over and discontinuing services that have never failed in generations.

Mr. Cortelyou presided but a few minutes after the opening of the meeting. Briefly outlining the reasons for its being called together, he turned the chair over to Philip J. Gadsden, chairman of the Emergency Commission.

Mr. Gadsden briefly outlined the national situation as it now exists.

To men filled with anxiety as to their own situations he offered the questionable condolence that they were not alone in their misery. Practical exhaustion of supplies is national, not local, with gas companies. They will enter next winter practically on a hand-to-mouth basis.

The morning was devoted to a complete picturing of the situation—financial and as to oil. Expert testimony from the outside, so as to speak, was presented as the basis for the constructive discussion planned for the afternoon.

N. A. C. Smith, of the U. S. Bureau of Mines, explained the ins and outs of the national oil situation. His paper is reprinted elsewhere in this issue.

Following Mr. Smith's paper Mr. Gadsden reminded the conference that the national oil shortage was not entirely the cause of the gas companies' inability to obtain it.

Even in times of shortage in any commodity the man who has the funds to go out in the open market and bid up against others can easily manage to get his needs supplied even though others go short.

The unfortunate part with the gas companies is that they are at the disadvantageous end. The seller of motor fuel is unregulated as to the price at which he may sell. So there is no limit to what he may pay to buy.

Lack of funds, after all, is basically the root of the gas companies' ill.

For enlightenment on how funds are got O. B. Wilcox, of the Investment Bankers' Securities Association, was introduced to the conference.

There is no formula that can be applied to the cost of money, according to Mr. Wilcox. Many factors vary from day to day. But there is no dispute as to the increased cost of money.

To obtain the cost to the utilities must be added to the investor's demand, now running up to as high as 8 3-10 per cent, the cost of issuing legal expenses, engraving, etc.

The factors that influence cost of money to industries are security, certainty and regularity of return.

During the whole history of utilities the net returns on investment have been less than that demanded and required of other industries.

The market value of utilities securities has declined out of proportion to unregulated industries.

Overcapitalization in the past with which utilities have been charged was due to the cost of money.

Utilities under regulation are not permitted to earn a sufficient margin to meet even a slight increase in costs. Unless regulation can re-establish the credit of the utilities it must acknowledge it is a failure.

There is a remedy for the situation available under regulation. There is no reason why an industry under regulation should provide a less rate of return than an unregulated industry.

A reservoir fund should be established by charging slightly higher than a reasonable rate of return so as to absorb the shock of costs rising too quickly for rate increases to take care of them.

In the afternoon session J. B. Klumpp discussed the oil situation from what might be termed the point of view of the gas industry's research.

The oil people being oversold on fuel oil contributed to gas oil shortage as the oil people had to make good the deficiency with this higher grade. Since these demands are about met some relief may be expected in gas oil as a consequence.

Transportation has also complicated matters. The big demand for gas oil is in the East. The greatest quantity available is in the Middle West. The transportation tieups keep it unavailable at the point of greatest need.

Substitution of lower grades of oil, due to machine stoppages caused through its use, will lower production per unit.

The automotive industry's demands are the cause of the gas industry's plight as to oil. The speaker deplored the excessive horse-power of the American motor car of to-day, giving an efficiency of but 5 to 6 per cent.

Mr. Klumpp is pessimistic as to benzol and alcohol substitution as motor fuel helping out much in motor fuel supply due to quantity producer. He took into account, however, only the by-product oven's potentialities as benzol producers and ignored the gas companies' possibilities.

Following Mr. Klumpp, Mr. Fogg supplied the following pertinent data:

Under regulated rates, the average price of gas in 150 cities has advanced 15 per cent in the past five years, from $1.09 per 1,000 in 1915, to $1.26 per 1,000 in 1919. During this period, all other commodities, necessities and luxuries, have gone to or well beyond the 100 per cent mark. We have been forced to pay unprecedented prices for all of our essential materials. Reports of oil conditions have been received from 141 gas companies. Only twenty-five have been able to make new contracts since the first of this year and of these but ten are for a term longer than six months. Eighteen of the contracts are at a flat price, averaging 10.87 cents per gallon (with a maximum of 14.81) and the remaining seven are at prices changing with variations in the price of crude oil, the average base of which is given at 10½ cents.

Fifty-two companies having unexpired contracts holding over from last year, are paying an average price of 7.33 cents per gallon (maximum 10.65), while the average price paid by fifty-three companies who are buying or have had to buy spot oil at the market was 12.24 cents per gallon (with a maximum of 18 cents). Last comes the small group of companies reporting quotations for contract supply (apparently not accepted) averaging 14.18 cents.

A price representing the average applicable to the first four months of this year is arrived at by excluding the hold-over contracts from 1919, and taking the prices reported by the eighteen companies purchasing on flat rate contracts made since January 1, and the fifty-three companies purchasing at the market. This produces a figure of 11.9 cents per gallon, or an increase of 223 per cent over the average price paid by 117 companies in 1915. In a number of cases companies are paying for oil four times as much as the 1915 average price, and 100 per cent more than twelve months ago. The tendency has been steadily upward since January 1—the averages for April would be well above those given for the four-month period—and the ultimate level cannot be predicted.

Coal has followed the same upward tendency. The average present price of a group of large contracts for anthracite coal, not including freight, shows an advance of 135 per cent over 1915. And a similar group of bituminous contracts reflects an average price advance of 220 per cent over the same period. These figures include no allowance for increased freight rates.

Labor costs have advanced, in the period from 1915 to 1920, 150 to 200 per cent, and a fair average would probably lie half way between these figures. About 90 per cent of the cost of gas is in the items made up of materials and supplies, salaries and wages, the very items in which such enormous cost increases have been experienced.

These figures of increased cost reflect the general condition which prevails throughout the gas industry. Those applicable to your own situation may show even more extreme conditions. These are the facts that must be forcibly presented to your public, using the figures that directly relate to your own enterprise. We are expected to render a certain definite service to the public, but we are denied the money and the power to do so. The situation that we are facing calls for prompt relief in the matter of rates adequate to meet such abnormally increased costs, and coupled with that must be the equally urgent demand for the immedite abolishment of candle-power standards in the thirty-six cities where they now exist, as well as the downward revision of high heat value standards to the point where there will be used only the minimum amount of oil necessary to produce a gas suitable for the satisfactory and economical use of the public.

Following Mr. Fogg, Mr. Gadsden took up once more with an outline of the Emergency Committee's objects. These are:

For quick relief, priority in shipments, prompt increases in rates, protest against coal and oil export, readjustments in standards.

For permanent stability of business an elastic rates system.

It hopes to accomplish these objects by public education through committee's local newspapers, local talks, national association addresses, education of officials and educators, the local press and utilizing the individual employee as a publicity agent.

Government Bureau Sees Little Hope for Gas Companies in Oil Situation Even in Future

How Refiners Being Oversold on Lubricant Made for Shortage in Gas Oil—Immediate Prospects of Relief—What May Be Hoped for from Oil Shales

Gas oil derives its name from the use with which you are all familiar; namely, the manufacture and enriching of artificial gas. The term "gas oil" is commonly used for two dissimilar products, according to N. A. C. Smith, of the U. S. Bureau of Mines, in his paper before the emergency conference of the American Gas Association. One is the heavy oil used on the Pacific Coast for the manufacture of illuminating gas; the other is the grade of oil used in the Eastern part of the country to enrich water gas. This oil is the one with which we are concerned at present. As you all know, it is introduced into some form of carbureter through which water gas is flowing, and under the influence of heat is broken down into fixed gases of high illuminating and heating value.

This grade of overhead gas oil is one of the many products obtained from the distillation of crude petroleum. The oil from the wells is pumped into receiving tanks, and then into large reservoirs on tank farms in the oil fields. From these tank farms it is transmitted by pipe lines to the refineries. When the oil reaches the oil refinery it is pumped into the crude stills, which are very similar in construction to ordinary steam boilers, except that there are no tubes inside the shell. A fire is started under the still, and as the oil is heated vapors begin to come off. These vapors are passed through coils of water-cooled pipe and condensed into the liquid state. The stream of condensed liquid is examined at intervals and the specific gravity is noted, because as the distillation proceeds the specific gravity and the boiling point of the condensate become higher. When certain predetermined specific gravities are reached the stream of liquid is diverted from one run-down or running tank to another. Thus several so-called "cuts" or "fractions" are obtained.

Gas Oil the Third Fraction

The first product obtained in this way is called "crude naphtha" or "crude benzine." After further refining this becomes gasoline. The second fraction is called "kerosene distillate" or "burning oil distillate," and after further refining is sold as kerosene. The third fraction is gas oil, which is usually sold without further refining. The fraction obtained after gas oil is known as "wax distillate" or "lubricating oil distillate," and contains most of the paraffin wax (when wax is present) and the light lubricating oils. The distillation is sometimes carried on until the residue in the still consists only of coke. However, a number of the various crude oils of this country yield so small an amount of lubricating oil, or contain so much asphalt, that it has not been considered profitable to completely refine them. These oils are therefore topped; that is, the gasoline and kerosene and some of the gas oil is distilled off, and the residuum is sold as fuel oil.

The fraction we are interested in at present is the third, or gas-oil, fraction. As the various fractions are differentiated in practice by the gravity alone, and as commercial distilling methods never give a complete separation, it is usual for the gas-oil fraction to contain a certain amount of low boiling material that could be used as kerosene, also a certain amount of material which could be used as light lubricating oil. It is evident also that when there is a shortage of kerosene the refiners will try to use as much of the gas-oil fraction for kerosene as possible. This, of course, tends to cut down the supply of gas oil. On the other hand, when the price of gas oil is relatively high, as it was during the war, a considerable amount of material which could be used as light lubricating oil will be included in the gas-oil fraction. In other words, the amount of gas oil actually made from each barrel of crude oil depends a good deal on market conditions.

For a number of years gas oil was used only as a fuel for steam boilers, for metallurgical work, glass-making and similar purposes, and to enrich water gas, for which demands there was an abundant supply. At the present time, however, two other large uses have come into existence. The first is as a raw material for the manufacture of gasoline; the second is as a fuel for Diesel-type engines.

It was found in the early days of the petroleum industry that if oil vapors were allowed to condense during the distillation process and drop back into the hot oil they would break down into lower-boiling products. This process, which is called "cracking" in the oil refineries, has been used for a long time to produce more kerosene than could be produced by the straight distillation process. A few years ago it was discovered that if this cracking is carried on under pressure gasoline will be produced instead of kerosene, and this discovery has been developed until at the present time probably 15 per cent of the motor gasoline of the United States is produced in cracking stills. It is theoretically possible to crack any of the higher-boiling petroleum products to make gasoline. Practically, however, the choice of material for cracking has been limited mainly by the amount of carbon which will be set free, which in all processes used at present is undesirable. Gas oil, being practically free from carbon in the form of asphalt, or in suspension, makes an ideal raw material for the cracking process. The demand for motor fuel has been increasing faster than the supply of straight-run gasoline. Consequently the refiners have increased the number of cracking stills in use very greatly, so that at the present time a large part of the gas oil produced in the country is used for the manufacture of gasoline. This is the most important factor to-day in the shortage of gas oil.

The Diesel Engine's Demand Will Begin to Be Felt

Another use for gas oil which is not so large at present as the one just mentioned, but which shows every prospect of increasing, is the use of this oil as a fuel for Diesel engines. Diesel engines can operate on almost any form of fuel oil; but, just as in cracking, an oil similar in properties to gas oil is regarded as preferable. Small engines of the Diesel type are used in this country to-day, and the number in use will probably increase very rapidly as time goes on. I was informed in February of this year that one of the engine manufacturers had started making large Diesel engines, and that their first 2,500-hp. unit was at that time on the testing block. Large Diesel engines have been in use in foreign countries for a number of years; a particular instance of this is the great use of Diesel engines for marine purposes. A large and growing number of foreign built ships are propelled by Diesel engines, some of them employing as much as 20,000 hp. There is every reason to expect that these engines will prove equally successful in this country, and if this is true there may be dedeveloped a large demand for distillate fuel oil, which is another name for gas oil.

There are also some smaller uses for this gas-oil fraction. It is used either in its unrefined state or after being partially refined, as an absorbent or wash oil in the manufacture of benzol and toluol, and also is coming into considerable use as an absorbent in the manufacture of casing-head gasoline from natural gas. This process does not consume much oil, as most of it is recorded and used over. Some of it is given a complete refining, including a chemical treatment which renders it water-white in color, and it is sold as mineral seal oil for illuminating purposes.

All These Uses Legitimate

These uses are all legitimate, and must be considered as a permanent factor in the situation. One other use, however, of this grade of oil must be mentioned. In the Eastern part of the country, particularly along the Atlantic seacoast, there are a large number of manufacturing plants which use oil as fuel, under boilers or for heating forges and metallurgical furnaces. A good many of these plants are equipped with old-style oil-burning equipment capable of burning only very light fuel oils. Thus these plants are a factor in the demand for gas oil. This use of the produce should be discouraged, as it is too valuable economically to be used simply as fuel where other grades of fuel oil or other fuels could be used with success.

During the early years of the petroleum industry —in fact, up until the war started—there was a sufficient supply of gas oil for all purposes. During the war there was a great demand for gasoline and fuel oil, and this was one of the causes which led to a great increase in the expansion of the petroleum industry. Immediately after the armistice there was a falling off in demand for fuel oil of all grades; but this demand has increased again, until at the present time there exists a competition between various users for all grades of petroleum products. In other words, a few years ago the supply of crude oil was large enough so that all classes of demand could be met, but to-day there is not enough crude being produced in this country to supply all the demands. This means, of course, that the competition between various users is becoming the controlling factor in the petroleum situation. And, as already stated, although the growing use of oil for fuel in the Navy and Merchant Marine, and for Diesel engines, adds to the difficulty, the demand for gas oil as a raw material for the manufacture of gasoline is the principal factor in the situation as applied to the manufacture of gas.

Outlook Not Bright

The manufacturer of gas, then, being confronted with the shortage, will naturally ask, "Is there any relief in sight, either now or in the future?" It is impossible to give a definite answer to this question, but at the present time the outlook is not encouraging. In the first place, the demand for gasoline will undoubtedly increase. There were 7,500,000 automobiles and trucks in use in this country on Jan. 1 of this year. It is proposed to build more than 1,500,000 additional during 1920, an increase of 20 per cent. At the present time there is difficulty in supplying enough gasoline to meet the demand, so that it certainly is not going to be easy to divert supplies of gas oil away from the cracking plants. The use of the oil engine is also likely to increase, especially if, as seems not impossible, an efficient engine that can use heavy oil as fuel is designed for use on farm tractors and heavy motor trucks. Thus the two largest competitors of the gas industry for gas oil are practically certain to become more formidable as time goes on. On the other hand, the U. S. Geological Survey reports that the output of crude petroleum in this country has probably closely approached its maximum, and may soon begin to diminish instead of continuing to increase. In a recent article entitled "Petroleum Resources of the World" David White, of the Geological Survey, estimates that between six and eight billion barrels of crude oil are still available in the oil fields of the United States. If the present rate of consumption is continued this supply would be exhausted in about twenty years. The most liberal estimate which the Survey is willing to make is that there is only twenty-five years' supply of oil left in the United States. Of course, this oil will not be all used up in twenty-five years, as it is a physical impossibility to get it out of the ground fast enough; but it is probable that there will be a continuous decline in production which may begin at any time within the next few years. Should it prove that the Geological Survey is too conservative in its estimates, and we should double their most liberal figures, the situation would even then be unsatisfactory.

Converting Heavier Oil to Lighter Distillates

There are, however, some features of the situation which are more hopeful. In the first place, a great deal of heavy fuel oil is being consumed for steam raising, because it has not been found practical to refine this grade of oil economically for other uses. Experimental work is being undertaken to convert this heavy fuel oil into lighter distillates,

(*Continued on page* 427.)

Three-Part Rate Reduces Average Rate Per Thousand from Eighty Cents to Seventy-Five Cents

Henry L. Doherty Points Out, However, That in Pressure System Leakage Is Reduced Thirty Per Cent Without Expenditure for Main Repairs

Since some of the data which follows was obtained in Ottawa, Kan., where the three-part rate is in effect, it may be well to summarize here some of the facts in connection with that installation, declared Henry L. Doherty in a paper on "Service and Conservation Under the Three-Part Rate" delivered at the annual meeting of the Natural Gas Association of America.

Ottawa prior to the installation of this rate was being served by the Ottawa Gas & Electric Company with natural gas at a straight meter rate of 80 cents per 1,000 cu. ft. The three-part rate, which was substituted as of Jan. 1 for the straight meter rate previously in effect, consists of—

A customer charge of $9 per year per customer, payable in equal monthly instalments.

A demand charge of 32 cents per year per foot of maximum hourly demand, payable in equal monthly instalments; and

A consumption charge of 40 cents per 1,000 cu. ft. of gas consumed.

After the adjustment of his appliances each customer chose such a maximum demand as, with the advice of the company's service department, he determined was necessary to supply his need. There was installed on his service an Empire limiting meter which restricts the flow of gas to the point that the customer in one hour secures only that number of feet of gas for which he pays a maximum demand.

As one result of the installation there was a 50 per cent cut in the maximum possible demand on the lines of the Ottawa Gas & Electric Company in any given hour.

The average rate at which gas was sold in Ottawa of 80 cents per 1,000 cu. ft. was reduced to approximately 75 cents per 1,000 cu. ft.

The contract which the customer will sign in Ottawa, and by which he agrees to pay a certain demand charge per year, will guarantee that demand to him at any time he may desire it within that year. Failure of the company to deliver that amount of gas at any time the customer may desire it will entitle the customer to a rebate of ten times the demand charge for the period and proportion of such failure.

The reduction of leakage that can be made without the expenditure of anything for main repairs will amount to about 30 per cent. This follows the installation of the limiting meters on the services of the customers, reducing their maximum demands and thereby reducing the pressure that it is necessary to carry in the mains.

The Requisite of a Proper Rate

From the standpoint of equity, the rate must distribute all of the costs of service between individual customers in direct proportion to their responsibility for those costs.

From the standpoint of public policy, a proper rate must penalize extravagant and wasteful uses of gas and put a premium on its efficient utilization, while under the law the rates must be non-discriminatory.

From the standpoint of continuation of service, the rates in effect must allow the company an adequate revenue to properly maintain its operating department and an adequate and efficient plant.

I believe that the three-part rate fulfills all of those conditions.

Basis of the Three-Part Rate

There are in this rate three separate and distinct charges, referred to respectively as customer charge, demand charge, and consumption charge.

Under the customer charge there are distributed equally to each customer those expenses which bear no relation to his maximum demand in a given hour or to his total consumption in the year. Under this heading fall the cost of meter reading, bookkeeping, labor, postage and stationery necessary to render bills; the expenses of the cashier's department, meter-testing department and fixed charges on that portion of the investment which is proportional to the number of customers on the system, irrespective of their demands. The total of these expenses for a company having 10,000 customers will be practically twice that of the company having 5,000 customers, and therefore should be proportionate to and distributed equally among the number of customers connected.

Under the demand charge there are distributed to each customer, in proportion to his maximum hourly demand, those fixed charges on that portion of the investment which does vary with the maximum demand placed on the system.

The two chief factors which determine the size of the investment of a particular company are, first, the number of customers, and, second, the maximum demand that those customers place on the lines at any given time.

Our organization at one time had offered to them by-product coke oven gas and we had two options as to where we would sell it. One of them was to a town in which we estimated we could get about 10,000 domestic customers, and the other was a small group of industrial concerns. Either one would absorb all the gas we had available and their load characteristics were very similar. To supply 10,000 customers at fifty customers per mile would require 200 miles of street mains. These, at $5,000 a mile, would cost $1,000,000. In addition we would have to set 10,000 meters at about $15 each, or $150,000 more, making a total of $1,150,000. If we supplied the industrial customers we would only have to supply a mile or two of pipe and a few large me-

ters, making a total investment of considerably less than $100,000.

The difference in these two cases, then, is the difference in the number of customers of about 9,990 and a difference in investment of about a million dollars. In other words, those 9,990 additional customers required investments of over $100 apiece. Interest, depreciation, maintenance, taxes, etc., at 10 per cent means an annual charge per customer of $10. To this we must add the collection expense and a portion of the general expenses, which would be about $4 or $5 a year, making a total cost of $14 per domestic customer.

You will say that this figure includes in the distribution system provision for demand, but the same is true for the industrial customers. The demand is the same in both cases, the only difference being the number of customers. In other words, it costs us $14,000 a year solely because we must deliver this gas to 10,000 places on 200 miles of street, instead of to only one or two places on four or five miles of street.

The size of the transmission lines is, of course, dependent on the size of the maximum demand, irrespective of whether that maximum demand is occasioned by supplying one customer or 10,000 customers. The fixed charges on that investment, the size of which is determined by the maximum demand, are distributed to each customer as a demand charge. The demand charge is uniform for equal demands and proportional to the demands. This is irrespective of the fact that one customer with a 50 cu. ft. demand may utilize his demand four times as long as does a customer with 100 cu. ft. demand, and therefore may in a day or a year use twice the amount of gas.

It is clear that neither the customer expense nor the demand expense forced on the company for service to a particular customer bears any relation whatever to the total amount of gas which that customer may use in a month or a year.

Under the consumption charge there are billed to each customer those expenses which vary directly with the amount of gas which the company must supply, and these charges are billed to each customer directly in proportion to the amount of gas he consumes. As was pointed out in the paragraph on the demand charge, the customer with a 50 cu. ft. demand may use twice as much gas in a given month or a year as the customer with a 100 cu. ft. an hour demand.

The total cost to the company for gas alone would be identical whether they supply one customer using 10,000,000 cu. ft., ten customers each using 1,000,000 cu. ft., or one thousand customers each using 10,000 cu. ft.

We have three distinct classes of cost, each of which varies with a factor that does not influence either of the other two classes. Under the three-part rate each customer is billed with each class of expense in proportion as he makes that cost necessary.

Conservation

The conservation of gas that follows the installation of the three-part rate is divided into two general divisions:

First—Since the largest saving to be effected is in the homes of the customers, the gas companies have been pointing out to the public the necessity for the conservation of gas. Various branches of the Federal and State governments have been printing booklets and utilizing the press to reach the public, without any appreciable effect.

It is my conviction that until such time as the customer appreciates he is directly interested in gas conservation no progress will be made. In the installation of the three-part rate this direct financial interest of the customer is brought to his attention at once when he realizes that he must pay a monthly premium unless he uses the gas in efficient appliances properly adjusted.

There is available to him under the three-part rate any sized demand which he may care to take, and his demand charge is proportionate to any maximum demand he chooses. Exhibits of appliances and their varying demands indicate to him the amount of the premium he must pay for the continued use of an inefficient appliance, and he at once will have his appliances adjusted if that will lower his demand charge, or he will supplant the inefficient with efficient appliances if that be necessary.

In our various surveys we find cooking ranges burning as high as 106 cu. ft. per hour, while we have found it practicable to cook meals for twenty people with a demand of 30 cu. ft. per hour on identical appliances properly adjusted.

Under the three-part rate as installed at Ottawa, Kan., the difference in the annual demand charge between those two cooking ranges, one properly and one improperly adjusted, would be $24.32.

The customer also learns the saving which he would make in the consumption charge under the change in efficiency.

We have not through publicity in the past received the co-operation of the public, but there can be no question that when a customer is told he has to pay $24 per year for the privilege of using an improperly adjusted range he will at once have that range adjusted.

The effect of this can best be appreciated when you consider that the average demand per customer of 1,962 customers in Ottawa, prior to the time their appliances were adjusted, was 118 cu. ft. per hour; that at the present time, with the limiting meters installed in November, December and January, the total maximum demand that can be placed on the system by these same 1,962 customers is 114,502 cu. ft., which gives an average of 58.4 cu. ft. per customer.

This does not mean that the customers had the service which they previously received reduced. In fact, many of these customers are getting more service at the present time than they had prior to the adjustment of their appliances, for the simple reason that under the flat 80-cent rate they could not afford to do any house heating. They now do considerable incidental heating which comes within the capacity of their demand-limiting meter, for which their additional cost over and above the cost of their other service is only the additional 40 cents per 1,000 cu. ft. which they have to pay as a consumption charge.

The effect on the service, from the standpoint of the company, can be realized when a comparison is

(*Continued on page* 428.)

By-Product Coke Plant Will Produce 560 B.t.u. Per Cubic Foot Even Stripped of Benzols

C. J. Ramsburg, F. W. Sperr, Jr., and Joseph Becker Discuss Its Availability for Helping Out Natural Gas Shortage

It is the purpose of this paper to point out some of the opportunities afforded by the by-product coke industry in the way of supplementing our natural gas supply, declared C. J. Ramsburg, F. W. Sperr, Jr., and Joseph Becker, in a paper presented before the annual meeting of the Natural Gas Association of America. Some of these opportunities have existed for a number of years, but are greatly increasing in importance on account of the rapid growth of the industry; others arise from recent technical developments, and all deserve careful consideration in view of the increasing shortage of natural gas in many districts. The conditions and seriousness of this shortage are too familiar to require description here. They have been created not only by exhaustion of natural gas in districts that owe an important part of their industrial development to the availability of this valuable fuel, but they are due also to inadequacy of supply in proportion to demand in a number of districts where the supply has even greatly increased. The situation is such as to demand the utilization of every possible economical means of augmenting the supply of natural gas. Much of the realization of the advantages of gas as industrial and domestic fuel has come through the exploitation of our natural gas resources. Any relapse to the use of the more wasteful types of fuel would be a serious economic mistake. The maintenance and development of the use of gas are essential from the standpoint of conservation of natural resources, apart from all other considerations.

The supplementing of natural gas with high-grade artificial gas should be considered apart from the use of low-grade gases, such as producer gas, which, if used in large quantities, produce mixtures of relatively low heating value. The low-grade gases are such as cannot be used alone without extensive modifications of the appliances in which they are consumed. We shall not, at present, give further attention to the use of these low-grade gases, but shall proceed with a discussion of the high-grade gases which include coke oven gas.

Of the high-grade artificial gases available with present methods of manufacture, only two, viz., coal gas and carburetted water gas, deserve serious consideration in this connection. A very important factor in the cost of carburetted water gas is the price of gas oil, and this has increased to such an extent as to make any large scale competition of carburetted water gas with coal gas out of the question. Moreover, we are beginning to face a condition of oil shortage quite analogous to our natural gas shortage. This condition is seriously embarrassing the manufacture of carburetted water gas in many plants and has already led to the erection of a number of coal gas plants.

The typical apparatus for the manufacture of coal gas is the gas retort, in which relatively small charges of coal are heated to high temperatures, primarily for the sake of the gaseous product; the coke residue, and the by-products being of relatively minor importance. This method of manufacture was introduced over 100 years ago and is still extensively employed. However, with the introduction and development of the by-product coke oven, which occurred many years later, it was soon realized that this, if properly designed, constituted an apparatus not only adapted for the manufacture of metallurgical coke, which was its primary purpose, but also capable of furnishing a high-grade gas—just as truly "coal gas" as that manufactured in the gas retort. The credit for this realization and its commercial development is very largely due to American enterprise.

It may be of interest to state briefly the advantages of the by-product coke oven over the gas retort for the large scale manufacture of coal gas.

1. The quality of the gas produced is equal, if not superior, to that of the gas retort.

2. The coke is of superior quality and commands a better price and wider market.

3. There are the following advantages with relation to the by-products.

(A) The yield of ammonia from the same coal is greater.

(B) The quality of the tar is better especially with respect to higher content of oils and lower percentage of free carbon, except possibly in comparison with the vertical retort.

(C) The yield of benzols is greater.

4. The coal and coke are handled mechanically in relatively large masses. This results in great economy in labor in comparison with gas retort operation, which, in many cases, requires much hand labor of a particularly arduous and unpleasant character. Where mechanical handling machinery and other labor-saving devices are installed in the retort house, the items of interest, depreciation, and repairs are excessive in proportion to the tonnage handled.

5. The plant is much more compact and occupies less ground space than the best designed retort plant of equal capacity.

6. The heating efficiency is greater.

7. The life of the plant is longer and repair charges are less.

The first plant of by-product coke ovens built to supply gas for domestic purposes began operation in Boston about twenty years ago. During the subsequent period, the utility of coke oven gas has been so firmly established that no argument is necessary to prove it. The annual consumption of this fuel for domestic and industrial purposes, outside of iron and steel plants and other establishments with which the by-product coke plants are directly connected, is approximately 40,000,000,000 cu. ft., and indications are that this amount will be greatly increased in the next few years. The following cities obtain either all or a large part of their gas supply from by-product coke ovens:

Baltimore, Md.	Milwaukee, Wis.
Boston, Mass.	Newark, N. J.
Camden, N. J.	Providence, R. I.
Detroit, Mich.	St. Louis, Mo.
Indianapolis, Ind.	St. Paul, Minn.
Jersey City, N. J.	Terre Haute, Ind.
Joliet, Ill.	Toledo, Ohio

Both theory and experience have shown that coke oven gas is better adapted for mixing with natural gas under practical service conditions than is any other artificial gas. Straight purified coke oven gas, stripped of its benzols, and having a heating value of about 560 B.t.u. per cu. ft. and a specific gravity of 0.42, will be the most commonly used for this purpose. Assuming the use of such a gas, the following points should be specially noted:

1. As compared with the low-grade gases, the heating value of the coke oven gas is relatively high. Thus small variations in the composition of the mixture, occasioned by variations in the rate of flow of the two gases at the point of mixing, have relatively much less effect on the heating value of the mixture and, therefore, occasion much less inconvenience and loss of efficiency at the point of consumption.

2. In comparison with low-grade gases, the coke oven gas has a much lower specific gravity. The investment and power required for conveying a given number of heat units in the form of coke oven gas are much less than in the case of a low-grade gas.

3. The cost of removing sulphur compounds from coke oven gas per B.t.u. is much less than in the case of the low-grade gases.

4. It should be observed that coke oven gas, properly manufactured, is relatively a dry gas, for under practical conditions of compression and distribution there are no hydrocarbon condensates or loss of heating value. Condensates from other gases have been found to have an injurious effect on some of the materials used in the meters and other appliances that are commonly used for natural gas.

Of course, in any scheme contemplating the distribution of mixed gases, it is important to maintain fairly constant proportions, so that the consumer may receive a fuel that does not vary so greatly in specific gravity, air requirement, and heating value as to produce loss of efficiency at his burners. The flexibility of coke oven operation is such that the gas can be supplied in the desired proportions for widely varying rates of demand, while actual variations in the proportions added have much less effect than in the case of low-grade gases.

Of particular interest in connection with the use of mixtures of coke oven gas and natural gas, is the amount and character of the sulphur compounds present in the former. The amount of sulphur in coke oven gas is considerably less in proportion to the heating value of the gas than in the case of producer gas made from the same coal, and since producer gas is generally made from high sulphur coals, the difference is even more pronounced. Before purification, coke oven gas contains from 300 to 700 grains total sulphur per 100 cu. ft. From 8 to 15 grains of this is in combination with carbon principally as carbon disulphide, while the rest is present as hydrogen sulphide. The first class of sulphur compound is, in this case, insignificant and does not require removal. The hydrogen sulphide is readily removed by the usual method of iron oxide purification that is well established in the illuminating gas industry. Recent developments have indicated the possibility of greatly improving the process of purification in connection with the operation of a by-product coke plant, so as to reduce materially the cost of removing the hydrogen sulphide. In any case, the cost is relatively much lower than that of purifying producer gas.

To those who are familiar with the enormous rate at which natural gas is being produced and consumed, it might seem that any artificial source of supply must be small in comparison; nevertheless, a study of the statistics shows that the present production of by-product coke oven gas and the potential resources for largely increasing this production are by no means trifling. It is estimated that the average normal consumption of coal for the manufacture of coke during the next five years will be approximately 86,000,000 net tons per year. If all of this coal were coked in by-product ovens, we should have a gas yield of 10,500 cu. ft. per ton, or a total gas production of 900,000,000,000 cu. ft. of gas per year, which is probably a greater volume than the present annual production of natural gas. This figure represents the maximum possible gas production in connection with coke manufactured at the present average rate. We have not, however, reached the ideal condition when every ton of coke will be made in by-product ovens. Of the 86,000,000 tons of coal used for the manufacture of coke, it may be estimated that, during the next five-year period, 46,000,000 tons will be coked per year in by-product ovens, with a total gas production of 480,000,000,000 cu. ft. The waste of gas from beehive ovens will continue at a rate of 420,000,000,000 cu. ft. per year. Natural gas men, who are quite frequently accused of perpetrating gross extravagance, may find some comfort in reflecting that the annual waste of good coke oven gas is equivalent in volume to half the annual production of natural gas. Worse still, the bulk of the beehive oven waste occurs in districts that need the gas and could use every cubic foot of it to advantage, while much of the present loss of natural gas occurs on the far-away prairies of Kansas, Oklahoma and Texas.

With assurance of the magnitude of gas production from by-product coke ovens, it is now in order to discuss the various factors affecting this production. These may be grouped under the following heads:

1. Gas requirements of the by-product oven.
2. Gas requirements of the iron and steel industry.
3. Geographical considerations.
4. By-product coke plants for gas manufacture independent of iron and steel plants.
5. Manufacture of mixed gases.

Gas Requirement of the By-Product Oven

At present, it is the usual practice to employ part of the gas produced in the coking operation for heating the ovens. With the development of the modern regenerative oven, a high degree of heating efficiency has been obtained and the records of a number of Koppers plants show less than 40 per cent of the total gas used in coking the coal. This amounts to approximately 8 per cent of the calorific value of the coal. The remainder of the gas, amounting to from 6,000 cu. ft. to 7,000 cu. ft. per net ton of coal charged, is surplus available for use outside of the plant and may be either straight gas or "rich

(*Continued on page* 432.)

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Contents of This Issue

EXTREME GRAVITY OF GAS COMPANIES' SITUATION IMPRESSED ON THOSE IN ATTENDANCE AT EMERGENCY CONFERENCE 417

GOVERNMENT BUREAU SEES LITTLE HOPE FOR GAS COMPANIES IN OIL SITUATION EVEN IN FUTURE 419

THREE-PART RATE REDUCES AVERAGE RATE PER THOUSAND FROM EIGHTY CENTS TO SEVENTY-FIVE CENTS 421

BY-PRODUCT COKE PLANT WILL PRODUCE 560 B.T.U. PER CUBIC FOOT EVEN STRIPPED OF BENZOL 423

EDITORIALS 425

As the Journal Views It

A Close-Running Gas Company Expensive to the Consumer

A few years ago some gas companies were actually making money. It is unfortunate for their consumers that their period of prosperity did not continue for a decade or so at least. If it had, in the communities served by these companies we might have seen gas service that for completeness and finish would have approached almost the superlative.

Some human beings are essentially and entirely miserly and hoggish. Whatever they get in the way of an unusual or unexpected profit they retain close unto themselves. But these are exceptions, and freaks. Given a fair and reasonable living, the average man is vastly more interested in his business itself than he is in the money he gets out of it.

Those gas companies which before the war were doing well found money in their hands beyond the current day's needs. Given the idea, they had the means to improve their service—and service in those times was a much-discussed item.

They talked free maintenance of domestic lighting fixtures and other appliances; they tested and studied all appliances they considered for sale; some of them even went into homes, without invitation or solicitation, and cleaned the burners on consumers' ranges. They were in constant search of means to insure the consumer's getting the utmost from his gas.

They were headed in the right direction, but too soon they were forced to curtail. Nowadays most of them are too engrossed in ways and means of ac-

tually getting the gas to the consumer to even think of the embellishments.

But back to it we must come. Gas is the ideal fuel—an expensive fuel—but, at no matter how high a price within reason, the economical fuel if properly used.

Up to the present day it is questionable indeed if there is not a considerable waste in usage in nine hundred and ninety-nine homes out of a thousand. If this were not so, even dollar-and-a-half gas in cities of dense population would have no terrors to the consumer. In fact, when we look back at it and remember how many families at dollar gas had annual bills less than twenty-five dollars, and consider the wastage, we are almost aghast at how cheap gas had actually gotten to be.

Of course, the waste is the consumer's own fault and he foots the bill. But it is the gas company that reaps the harvest in bitter reproach and unjust recrimination.

So we say it is unfortunate for the consumer that the gas companies' days of prosperity were not longer lived. The gas barons did not, as per fanciful repute, indulge themselves in continuous orgies of melon-cuttings. They satisfied themselves with moderate dividends and the surplus remained available for improvements to service and financing efforts to help the consumer get more out of the gas he burned.

And it may be that in communities intent upon exacting their pound of flesh there are many consumers at one-dollar gas spending more money for the service they get out of it than they would be with dollar-and-fifty-cent gas with the advisory and maintenance service the gas companies were tending toward to assist them. Oftentimes the cheapest service is the most expensive after all.

Something Else Besides

Without concentration very little useful work would be accomplished. But even concentration may be practised with reason. Overdone it is just as apt to be destructive to success as underdone.

By all means while you are at the task in hand concentrate on it. When it is finished, or active work on it temporarily suspended, forget it—or provide yourself with some other interest to help you forget it.

Let this be a real interest, so all engrossing that when you leave the gas office for the day you will be so lost in this other interest that you will not remember even that there is any such a thing as a gas company.

Some men have found this other interest in gardening, others in poultry. We knew a foreman of a water works shutoff gang who found it in painting—not house painting and crude things like that, but real art—sailing ships on seas of rare blue, pugilists and similar subjects. In selecting such an interest the great thing, of course, is to select something that one's tastes naturally incline to. But if the two can be harmonized, the most sensible recreational interest is one that is different entirely from the associations and surroundings of the vocation from which he gains his livelihood and that contributes to the maintenance of rugged health. An indoor man, for instance, will benefit most if he selects as his recreational interest something that will take him out of doors.

The great thing, of course, is to get something that will get our noses temporarily off the grindstone; that will make life something different than just eating, sleeping and going to work; that will make us forget our jobs long enough so that they do not become mere routine—just the same old thing day after day—and we may come to them each morning in the expectant frame of mind that is the natural accompaniment of tackling something new.

Extreme Gravity of Gas Companies' Situation Impressed on Those in Attendance at Emergency Conference

(*Continued from page* 418.)

Mr. Gadsden drew a sharply defined picture of the gas companies demoralized and famished in a land of plenty.

They are called upon for extensions to capacities beyond anything hitherto known in their collective history.

From 125 to 150 million dollars a year of new capital are required by gas companies to keep up with normal growth.

The emergency committee, Mr. Gadsden announced, has established permanent headquarters in the Hotel Pennsylvania, New York City, with Snowden H. Sommers, formerly city editor of the *New York Evening Telegram*, in charge.

In the discussion that followed Mr. Mullaney, of Chicago, created the first big stir.

Mr. Mullaney hasn't approved of some of our ways of handling things. He hasn't been with us long enough to altogether get his bearings in regard to what is justified and what is not justified in the various notions that are prevalent as to the gas man's being inclined to tarry somewhat behind the procession in the march of progress.

Mr. Mullaney, despite the spirit of the meeting, remains somewhat skeptical as to how far the gas industry is ready to go in a policy of frankness and laying its cards on the table. If the atmosphere that hung over the gathering meant anything it meant that every man there was ready to go home and promptly throw overboard everything and anything that savored of secrecy and holding back.

Mr. Mullaney suspected they were promising with their fingers crossed. He was quite frank in stating his belief.

Mr. Mullaney challenged the assemblage as to how much real nerve the industry has displayed in the past.

Had it dared to challenge and refute the "watered stock" charge that is so frequently bandied about?

Mr. Gadsden, in his address, had demonstrated just how much the watered stock element enters into the utilities plight. In the street railway field the company

that was in the worst state of all from lack of relief in rates was proved to have invested one hundred and ten dollars actually invested for every hundred dollars of capitalization.

The assemblage manifested a tendency to shrivel up in its respective seats at Mr. Mullaney's challenge. Having gotten by so successfully with that shot Mr. Mullaney essayed another.

Had the gas industry dared to refute the charge of ceaselessly working meters?

Mr. Mullaney was so sure he had them this time that he demanded that anyone who individually had shown the temerity to combat this charge to put up his hand. Almost everywhere where there was a chair there was a hand up, even on the speaker's platform. Then there was a laugh.

Mr. Mullaney had tripped. With a good many men such a setback would have killed the effect of an otherwise valuable discourse.

But not with Mr. Mullaney. He came back. And he offered enough of value and inspiration to amply justify that part of the conference's time that he took up.

Mr. McCarter, of the Public Service Gas Company of New Jersey was asked to offer a few thoughts.

The room was warm and Mr. McCarter was perspiring.

Mr. McCarter was willing to co-operate in any way with the objects of the Emergency Committee. But seventeen years of public service has left Mr. McCarter somewhat doubtful of the feasibility of any plan to obtain succor through appealing to the inherent sense of fair play of the American people. He didn't altogether doubt the public would be fair when it got around to it—"But, Great God!" he demanded, "when are they going to get around to it?"

Mr. McCarter declared that "commissions give the least they can get away with." He would take commission appointments away from pot-house politics and give them to lawyers. Questioning glances cast about here and there indicated that a large number of those present had considerably less confidence in lawyers than Mr. McCarter expressed.

A resolution was offered, after Mr. McCarter against such waste of oil as existing standards make necessary in gas manufacture.

This brought Randall Morgan to his feet.

Mr. Morgan was no less impressed with the gravity of the crisis that exists than were the others. But Mr. Morgan had faced crisis in the gas business before. Courage had brought the industry through then and he had no doubt similar courage would bring it through again.

He reminded the assemblage that he had seen the advent of oil into gas making. The present situation, he thought, spelled the end in its use in the manner we have been using it.

Mr. Morgan wants a preferential of oil for gas making over pleasure uses. He proposed a committee to confer with oil people to bring something like this about.

A resolution was offered to put the association on record as opposing as wasteful the use of oil to manufacture gas to candle-power higher than 450 B.t.u. thermal standard as wasteful. The resolution was aimed particularly at the wastage in New York and Philadelphia on the basis that while these cities were persisting in their orgy of stupidity they are withdrawing for unessential and frivolous reasons supplies for want of which smaller communities will shiver and suffer.

Modified so as to avoid mention of the B.t.u. standard and condemning only candle-power standard this resolution was passed.

Arthur Hewitt called to the attention of the gathering that in Canada under the practical test of actual supply and use a B.t.u. standard as low as 450 B.t.u. has not had the least effect in running up consumption.

Low Temperature Tar

Experiments have recently been made for the object of ascertaining the yield of ammonia and the quantity and quality of tar obtained by low temperature carbonization. The results show that, by distillation at low temperature, a poor coal containing 40 per cent of ash and 23 per cent of volatile matter, furnishes a tar superior in quantity and quality to ordinary gas or coke oven tar, and that the excess of value realized should be about 1 fr. per ton of coal treated, not including the costs of the process. Even if this profit were to be absorbed in the extra cost of production, there may still be advantages in the utilization of fuels that cannot be treated direct in the retort. This is, providing that the surplus nitrogen and gas can be recovered in the second stage of the operation, for the yields of ammonia liquor and gas obtained in the first stage, are much lower than those obtained by high temperature distillation. The study of this secondary phase of gasification has not yet been concluded.

Government Bureau Sees Little Hope for Gas Companies in Oil Situation Even in Future

(*Continued from page* 420.)

which will be adapted for more uses than is the heavy residuum. At the present time this problem is far from being solved, but there is reasonable prospect that it eventually will be. If this is done, there may eventually be produced a large amount of distillate fuel oil or gas oil. It will, however, be some years before this can happen. Even if a process were perfected to-day, it would take a considerable amount of time before the necessary plants could be built to make it commercially available, and probably when the work is complete there will be waiting a demand from the users of oil which will make the competition as keen as to-day.

Another source of oil which will undoubtedly become available in the future is oil shale. In the western part of the country, particularly in the States of Colorado, Wyoming and Utah, there are very extensive deposits of shale, which contains approximately a barrel of oil per ton. This shale oil is rather difficult to refine by ordinary methods, but it might be of great value to the gas manufacturers when it becomes available in large enough quantities. Here again we are faced with the question of time. The shale industry is still in the experimental stage, and even if a commercially successful process is developed at once it will be some time before enough shale oil can be produced to affect the situation to any marked degree, and by the time shale oil comes on the market in any large quantities it is probable that the demand for motor fuel will have increased so much that it will neutralize the additional resources developed. It seems probable, then, that the gas manufacturer will be unable to look to shale as a source of relief, at least for a long time to come.

Imports Can Be Increased

I have not yet touched on the question of imports. At the present time we are importing a considerable amount of oil from Mexico, and it is probable that these imports of oil can be increased, as new deposits have been found in Central and South America. These Mexican oils, however, will tend only indirectly to relieve the gas-oil situation, as they are usually high in sulphur and contain large amounts of asphaltic material. By relieving the fuel-oil situation, however, they may release other oils now used as fuel which would be more suitable for gas making.

It seems likely, therefore, that the present situation of undersupply of crude and keen competition for gas oil is one which the gas manufacturer will have to meet for some time to come. What, then, is he to do now?

A Lesson from the Pacific Coast

There are several things that can be done. On the Pacific Coast the manufacturers of illuminating gas have never had distillate gas oil to work with. Accordingly, a procedure has been worked out of using a heavy residuum oil for the manufacture of illuminating gas. This suggests that the Eastern gas manufacturers might also use heavy oil, although it is admitted that residuum fuel oils are not as well adapted for enriching gas as the distillate gas oils. It seems, however, to be necessary to try out all possible substitutes for the distillates; and the residuum fuel oils, if they can be used, will add considerably to the supply of gas-making materials. Moreover, these heavy oils are used at the present time chiefly for steam raising; consequently, if the gas companies can use these oils they will avoid the keen competition which now exists with the manufacture of gasoline. It seems probable, therefore, that it will pay the manufacturers of illuminating gas to investigate these oils very thoroughly.

Another suggestion is to use less gas oil; in other words, to make the supply go farther. In a number of States and municipalities the gas companies are required to make a gas that will meet some candle-power standard. As a measure of conservation of natural resources the Bureau of Mines feel that these candle-power standards should be abolished. As is well known, an open-flame gas burner is not economical. It uses more gas per candle-power than the mantle-type burner, so much so that most up-to-date users of gas prefer the mantle-type burner. It ought, then, to be possible to do away entirely with the old-style open-flame burner, and if that is done the candle-power standards for illuminating gas could be entirely done away with also. Of course, the States and municipalities will desire some form of standard for illuminating gas. A properly determined calorific standard would undoubtedly be the most satisfactory from all standpoints. If the candle-power standards are entirely done away with it will probably be possible for the gas companies to make a satisfactory gas with a smaller amount of oil than at present.

In conclusion I may say that I have considered this subject entirely as a petroleum problem. As you undoubtedly know, there is a good deal of experimental work being done on distillation processes for coal, lignite, peat, etc. It is possible that there may be developments along some of these lines which will be of great value to the gas manufacturer, but I do not feel competent to go into this phase of the subject. The question of making coal gas in the ordinary method is also out of my province, but it seems probable that economies are possible in this process which mikht make it commercially available. I say this because I know what has been found to be true of the oil-refining industry. Engineers of the Bureau of Mines have investigated several refineries from a standpoint of conservation of fuel, and they have found that it is possible to make very marked savings over what had previously been considered good practice. It is therefore possible that the same thing might be found true in the manufacture of gas. If so, it would certainly pay the American gas manufacturers to look into it.

Three-Part Rate Reduces Average Rate Per Thousand From Eighty Cents to Seventy-Five Cents

(*Continued from page* 422.)

made of the present maximum demand of 114,502 cu. ft. with the maximum demand under the old conditions of 231,516 cu. ft. in a given hour. This city at the present time has a gas service superior to anything it has heretofore experienced, and at the same time the company is supplying that service with less than half of the maximum demand previously made on its lines.

Housewives find that they can boil water more quickly; that their pots and pans are not blackened as they previously were with the improperly adjusted burners. When the summer comes the difference in the temperature of their kitchens will be appreciable because of the fact that the heat necessary to do their cooking is applied to the cooking utensils without a great surplus being radiated into the room, as was the case with the closed-top ranges and long flames necessary before the burners were changed.

Some of the appliances which we found in use while installing the three-part rate in Ottawa were scarcely to be recognized by any but the older gas men. For instance, we found Star burners, two in a set, which would be inserted in the firebox of an ordinary coal range and which for cooking purposes would take the place of two burners on a regular gas range. These Star burners used 450 cu. ft. of gas per hour, and under the Ottawa rate the demand charge alone on such a burner would be $144 per year. Needless to say, they are no longer in use. These Star burners were cheap from the standpoint of their original cost, but the consumer paid for them many times, burning gas at an 80-cent rate. Gas companies will find that the source of much of the feeling against them originates in devices like the Star burner, which increases the consumer's bill disproportionately to the service rendered.

Luxury of a Hot Bath

There is a picture in the booth of Henry L. Doherty & Co. of another interesting appliance which

we found and which has a demand of approximately 250 cu. ft. of gas per hour. The appliance has not been named as yet, but consists of a piece of gas pipe about 4½ ft. in length, with holes drilled in it, placed about 4 in. below a bathtub. The flames from this home-made burner impinged directly on the bottom of the bathtub.

These two examples are striking, it is true, but of little importance because of their rarity.

The real conservation that was effected was in the adjustment of otherwise efficient equipment and the resulting reduction in the gas consumption.

Meritorious as the objects back of the propaganda for the conservation of gas may be, it is my firm conviction, as it is the conviction of all of the men who had anything to do with the installation of the three-part rate at Ottawa, that so far propaganda has had no particular effect upon the public mind. I doubt whether a continuation of that propaganda, without the installation of a proper rate, will postpone the death of the natural gas business.

Second—We come now to another item of conservation which, while not so large as is possible in the homes, is large enough to have a marked effect on the earnings of the distributing company and on the continuation of the natural gas service.

It will be appreciated at once that the pressure in the distribution mains to supply the present Ottawa demand of 114,000 cu. ft. per hour is much lower than that needed for the demand of 231,500 cu. ft. necessary under the old conditions.

Leakage is the best customer, from the standpoint of load factor, the gas company has, but unfortunately does not produce any revenue. It is present twenty-four hours a day and varies in relation to the pressure in the mains. A great reduction in this leakage is at once apparent when the conditions under which the customers use gas are so changed as to enable a reduction in the distributing pressure.

We believe that in Ottawa, where we have in the past had maximum pressures of from 9 to 12 ounces, it will be possible with the reduced demands to distribute the necessary gas with a maximum pressure of 4 ounces. The saving in leakage by this reduction will be effected without any expenditure in main repairs and without any reduction in the quality of service.

Advantages of Rate When Supply Declines

Undoubtedly the conservation that can be effected in the homes of the customers and in the mains of the distributing companies by the installation of the three-part rate will greatly lengthen the life of the gas fields. It is nevertheless true that there is an artificial death date to the natural gas business that we are rapidly approaching.

With a continuation of the present straight meter rates, when the time comes that a company is no longer able to supply all of its customers it will be necessary to pick out certain groups and entirely discontinue service to them in order to better the service to the remaining customers.

With the three-part rate in effect we would know the maximum demand to which each customer was limited, and it would be practicable and easy for the proper regulatory body to decrease the maximum demand of each customer 10 per cent, for instance, by having installed limiting meters of smaller capacity. This would seem to be a much fairer method of bringing the demand on the gas company within its supply than would the method of discontinuing the service to some particular group.

Beyond the question of a doubt the remaining customers would decline to pay fixed charges on that portion of the property which had been scrapped, and would decline to amortize that portion of the property from which they never had had and never would have any service.

The proportionate reduction of service would, so long as it was practicable, permit the use of gas to more people for those services where coal and other fuels stand the least possibility of competing on an economic basis. If conservation means anything, it means the utilization of the least expensive and most efficient fuel for any particular operation.

If discrimination means anything, it would, to my mind, be applicable when gas customers on the north side of a particular town were asked to discontinue the use of a 1,000 B.t.u. gas at, we will say, $1 per 1,000 cu. ft. and begin using a 525 B.t.u. gas at $1.50 per 1,000 cu. ft. for the purpose of making good service available to the customers on the south side of town.

Discrimination in Service Under Meter Rate

Under the present straight meter rate we have conditions whereby a customer is discriminated against because of the location of his house.

The usual natural gas towns are belted with an intermediate pressure main from which the distributing system is fed. In the ordinary town the better residences are built on the outskirts of the town. The better class of residence presupposes on the part of the owners a financial ability to buy any number of appliances they may desire. The smaller homes and flats, which on the average are occupied by people with lesser incomes, are therefore necessarily located farther from the intermediate lines. With the unlimited demands present wherever straight meter rates are in use, it is impossible for the gas company to supply adequate service on cold mornings, because either the gas supply or the carrying capacity of the mains is insufficient.

When the pressure begins to drop on one of these cold mornings the natural inclination is to light more appliances, with the result that the available gas goes to those customers with the most appliances because of the fact that their homes naturally are located nearest to the intermediate lines.

During the extremely cold weather we have had days at a time in Wichita, Kan., when there was no gas in the poorer homes and where some of the better residences were using from 500 to 1,500 cu. ft. of gas per hour for house heating with inefficient appliances.

At the same time, these larger residences throughout the year do not use a proportionately greater amount of gas. The occupants of these homes go to Florida or California after the Christmas holidays and spend a large portion of the summer in Colorado.

If there had been a real need for the curtailment of service, the curtailment certainly should have been prorated. However, there was no need of a

curtailment of service; all that was necessary was a rate which would force the installation of efficient appliances. In one of the houses, for instance, we found appliances which, in the condition we found them, necessitated a maximum demand of 2,500 cu. ft. per hour. During the short time that these appliances were all in use the owner of the home was amply able to pay for whatever gas was used at any reasonable straight meter rate. Under the three-part rate his annual demand charge alone would have been $800 per year and, being perfectly able to buy efficient appliances, the changes which we suggested could have been effected at once and all of the service which we had previously received could have been supplied with a demand of 250 cu. ft. This would have made 2,250 cu. ft. per hour available to smaller consumers on those cold mornings and would have been sufficient to have operated seventy-five properly adjusted kitchen ranges.

This consumer, without doubt, believes in conservation as a theory, but until its practical application was forced to his attention no progress had been made and the authority which permits a straight meter rate to continue is discriminating against the very class they call the small consumer and whom they have every desire to protect.

I have cited one particularly bad case. I could, if space permitted, list hundreds.

Advance Information of Maximum Demands

Most natural gas companies have been most bitterly denounced by their customers for their lack of service on cold winter days. The customer does not know, and never will understand, why it is on the cold days especially that the service is inadequate.

Our service contracts under the three-part rate run for one year, as is usual with most utilities, and at any time we can tell the maximum amount of gas we can possibly be asked to supply in a given hour within the year to come. We can decline to sign up contracts for additional supplies when we have reached the limit of our capacity. We can apply to the commission for a pro-rata curtailment of the present contracts whenever the necessity for that move becomes apparent.

We therefore can keep the demands on us within our capacity and can guarantee that these demands for which we have contracts will be supplied with gas not only on the 4th of July but on the 1st of January.

I need not, before the members of the Natural Gas Association, dwell on the benefits of such a situation.

Effect on Appliances

In a preceding paragraph I have made reference to two particular appliances, the Star burner and a bathtub heater, the continued manufacture of which ought not to be encouraged.

We found in the installation of the three-part rate that we had to educate the owners of hardware stores, plumbing establishments and department stores on the subject of gas conservation. We found many of these people thoroughly imbued with the idea that it was unhealthy and impracticable to use ranges with spider tops and short flames. Appliance salesmen selling the other type of appliances had created this atmosphere and it had to be overcome before we could get the co-operation of these people.

It is obvious that many types of appliances that inefficiently use gas can be manufactured at a lower price than can a more carefully designed and built appliance which gives a greater efficiency. The first interest of the customer is in the original price of his appliance and the conservation propaganda starts out with this very decided handicap.

Under the three-part rate, however, the additional cost of an inefficient appliance is brought home to the consumer at once; and in the town of Ottawa, where this rate is in effect, it would be hard for the most plausible salesman at the present time to sell them an appliance that was not efficient. This rate practically prohibits the sales of inefficient appliances, and certainly puts a premium on the manufacture of others even more efficient than those we now have at our command. Any widespread adoption of this rate will have a tremendous effect on the engineering or research departments of every organization manufacturing appliances, and that recommendation alone ought to take the rate a long way toward adoption.

Who Is the Small Consumer?

Great opposition has been encountered in the past when endeavors have been made to install a rate which contains either a customer charge or a demand charge, on the basis that these rates unduly penalize the small consumer. This opposition on the part of city councils, public utility commissions and other regulatory bodies has been based on the mistaken idea that the small consumer is the man in poor circumstances. A slight consideration would convince most anyone that this theory is absolutely fallacious.

In which home do you suppose there would naturally be used the most gas in a year? Take first an apartment renting for $100 to $125 a month. Most apartments prohibit children, so we can exclude children from this family, unless the poodle-dog is counted. The size of the rent paid indicates that the man must have a fairly lucrative position and presupposes that he does not carry his lunch but eats at a restaurant or club downtown. It is likely the man of the house belongs to the golf club, and it is fair to assume that he has a vacation every year. It is perfectly safe to assume that the wife does not do her own washing or ironing; that the heat is supplied by the owner of the apartment, and that, therefore, the only uses for gas are for a light breakfast, an occasional dinner at home, and no luncheon, because a family of two doing little manual labor will probably have light meals.

In a case before the Kansas commission this particular type of customer was most aptly classified under the heading of "toast eaters."

As the other example, we have the man doing manual labor, living in a house or flat, usually with a good-sized family, all of whom have good appetites. It is safe to assume that if he is paying a rent not to exceed $50 a month he has to furnish his own heat and that his wife does her own laundry work; that he does carry his lunch, and that, therefore, there must be prepared the equivalent of three

square meals a day, together with the heating of a considerable quantity of water. In all reasonableness, which do you assume would be the larger gas consumer of these two homes?

You need not depend on theory, because for the year ending June 1, 1916, there was a survey made of hundreds of customers in Kansas City, Mo., with the idea of determining what monthly rent these customers paid and what their average annual gas bills might be.

It was found that in 444 homes, principally flats and two-apartment buildings, which had an average monthly rental of $24.77, the average annual gas bill was $25.74. For these people who had to furnish their own heat, and without doubt did their own laundry work, their average annual gas bill was approximately equal to one month's rent.

An analysis was then made of 1,123 apartments which rent on an average for $39.72 per month, and it was found that the average annual gas bill was $14.08. Included in this latter group there were 275 apartments that had an average monthly rental of $56.26, and for this group the average annual gas bill was only $12.72. In the two latter classes undoubtedly the laundry work was done outside of the home, and in the majority of cases hot water was furnished by the apartment owners, so that these customers used gas only for cooking purposes.

The gross revenue for the two latter groups could not have exceeded the actual customer's expense that service to them necessitated on the part of the company, and which under the three-part rate are grouped under the heading of "customer charge."

The fixed charges on the investment made necessary by the maximum demands of these customers and the actual gas supplied to them were either a gratuity on the part of the company or on the part of that class of customers which the regulating bodies have in mind when they say "the workingmen," or the small consumer.

Because of the straight meter rate under which this service was being rendered, these people, who could amply afford to pay the cost of service rendered to them, were nothing more than "charity patients." Under the three-part rate they would of necessity have paid all of the costs which service to them entailed on the part of the company.

The Three-Part Rate in the Electric Business

In consideration of the results that may reasonably be expected from the adoption of the three-part method of charging for gas, I believe it would be worth while to consider the comparative condition of the artificial gas plants and the electric plants in this country.

It is a matter of general knowledge that the great majority of artificial gas plants are unprofitable, while the great majority of the electric plants are profitable. In analyzing this situation it would be well to see what fundamental difference there is between these two classes of business:

First--They both sell a manufactured product.

Second—They are both regulated monopolies.

Third--In a given town the artificial gas plant will have more customers than will the electric plant, so that from the standpoint of the number of possible customers the gas business is most favorably situated.

Fourth—Without question the great majority of customers in a given town if told they could have only one of the two services would discontinue the use of electricity and continue the gas service, so that from the standpoint of comparative desirability the artificial gas plant has the preference.

The only fundamental difference between the two businesss that can account in any way for the difference in their financial condition is their method of charging for service.

At the present time at least 75 per cent of the electric current generated and sold in the United States is sold under some form of rate which takes into consideration the maximum demand which the customer places on the plant as one of the items on which to base a charge, and his total consumption of electric energy as another item.

Up to date. however, the artificial gas business has continued to maintain the old straight meter rate for charging, in which the total charge rendered to the consumer was based on only one factor of service, that being the total consumption.

In a preceding paragraph I have called attention to the apartments in Kansas City where obviously many customers were getting service at less than actual cost of reading the meters, rendering the bills and collecting the accounts. Where only a straight meter rate is in vogue the loss sustained by reason of the service rendered to this class of customers must necessarily be added to the actual cost of serving other customers, thus making the good customers pay a premium for their service over and above their fair share of the cost.

The old straight meter charge naturally invites unattractive business, and in proportion as it attracts unprofitable business it raises the rate which all must pay and discourages business from which a profit could be made. No industry can expect to succeed with such a program.

The three-part rate, however, in that it charges to each customer exactly the cost which service to that customer entails on the part of the company, naturally attracts more and more business from those customers to whom service can profitably be rendered at a low price per unit. Providing the unprofitable customers continue to use service subsequent to the installation of the three-part rate, they have at least to pay the cost of rendering that service, and are therefore not a detriment to the company. Inasmuch as the psychological effect of a fixed charge which the customers must pay anyway inclines them to use additional gas after having paid the fixed charges for their class of service, it tends to make good customers out of those who have heretofore been unprofitable.

There is no reason which I can see that would not make the gas business even more profitable than the electric business, providing they adopt the same form of rate schedule which the electric business has had in force for many years. The additional business that has been attracted to the electric companies, the rapid growth of those companies and the introduction of electricity in place of other power have been inducted by the form of rate which has been in vogue. The progress that can be made by the gas

companies after the installation of a properly designed form of charging will parallel that made by the electric plants in the last fifteen years.

Financial Considerations

The crying need of public utilities at the present time is sufficient credit to enable them to obtain the money necessary for improvements and extensions. A company operating under the three-part rate will, in my opinion, be a better credit risk for the following reasons:

First—No organization can afford to carry a sufficient number of high-class men to make a careful analysis of the conditions under which service will be used by each individual customer who applies to it for service. Under the straight meter rate such an analysis of each application would be necessary to determine whether or not a new customer's business would or would not prove desirable. Under the three-part rate this analysis is made once for all, and investors providing funds for extensions to take care of additional customers who are to be billed under the three-part rate have the assurance in advance that the company is taking on business on which they will not show a loss.

Second—Nearly all of the fixed charges and a considerable portion of the operating expenses are uniform from month to month. The principal variation in the cost of operation of a natural gas property is the total cost of gas, which runs much higher in winter than in summer. Under a straight meter rate the company shows a disproportionate amount of revenue above operating expenses in the winter months, and quite often shows a deficit below operating expenses in the summer months. Under the three-part rate, the fixed charges being provided for in the revenue secured from the customer charge and the demand charge, the total revenue follows these expenditures up and down month by month. The consumption charge furnishes the revenue to pay for the gas and varies in proportion as the gas purchased by the company must vary.

Third—The conservation of gas which follows the installation of the three-part rate tends to add permanency to any investment in the natural gas business, and therefore has a very desirable effect on the credit of the natural gas company operating under that rate.

Fourth—A properly devised three-part rate with a consumption charge based on the B.t.u. delivered rather than on the cubic feet of gas delivered makes it very easy to substitute a mixed or an artificial gas for natural gas as that necessity arises. This substitution can be made without any radical rate revision and with assurance to the investors who must furnish the money for the artificial gas manufacturing plant that the revenue will provide for the fixed charges on the additional investment.

Conclusions

The three-part rate by its very nature accomplishes the following:

First—Guarantees the customer that amount of gas for which he contracts, for every hour in the year, and makes it possible for the company to fulfill that guarantee.

Second—Conserves large amounts of gas by financially interesting each customer in adjusting his appliances to efficiently utilize gas.

Third—Conserves large amounts of gas by reducing the maximum demands of the customers so as to permit the company to supply these demands with much lower pressures in the distribution mains, thereby reducing the present leakage.

Fourth—It not only distributes the total cost of gas service to the customers as a group, but makes an equitable distribution of this cost as between individual customers.

Fifth—By conserving the present supply, and by making the same service possible with a smaller supply of gas, postpones the date when service must be curtailed due to the decline in the fields.

Sixth—Makes possible a pro-rata curtailment of service to all of the present customers instead of making it necessary to entirely discontinue the service to some customers when curtailment becomes necessary.

Seventh—Does away with the present discrimination in cold mornings whereby those customers nearest the supply lines use wasteful amounts, while other customers do without any gas.

Eighth—Permits the company to know for months in advance the maximum amount of gas it can be called upon to supply in any peak hour.

Ninth—Puts a premium on the manufacture and use of efficient devices and holds out a prize for the invention of devices using smaller maximum demands.

Tenth—Makes a better credit risk of any company which adopts it in place of a straight meter rate.

By-Product Plant Will Produce 560 B.t.u. Gas Per Cubic Foot Even Stripped of Benzols

(*Continued from page* 424.)

gas." In the first case, the surplus gas is simply an average of the total gas produced and has the same composition as the portion used for heating the ovens. In the second case, the plant must have a system of gas separation wherein the "rich gas," produced in the earlier stages of the coking process and containing higher heating value, is withdrawn and treated in a separate system of apparatus, while the lean gas, produced in the later stages of coking, is treated separately and used for heating the ovens. With properly selected coals, the modern by-product coke plant will produce straight gas having a heating value of 560 B.t.u. per cu. ft. after removal of benzols. It is usually assumed that gas separation will be necessary if local requirements call for a heating value of more than 560 B.t.u. per cu. ft., unless the benzols are allowed to remain in

the gas. The estimates in any case depend upon the kind of coal available. With gas separation, it is easy to produce surplus gas of over 600 B.t.u. per cu. ft., and the heating value may be still further increased by the use of benzol obtained from the lean gas to enrich the rich gas; but we believe that little consideration should be given to any proposition of supplying gas containing benzols. Considering the matter in its broadest aspect, apart from any arbitrary local standards, gas separation will, in most cases, be found not to be worth the additional investment and expense required. From an economic standpoint, the interests of the gas producing company and consumer are identical and both are beginning to recognize that the old standards of high candle-power and high heating value are expensive and unnecessary. The present tendency, in building by-product coke plants for gas manufacturing purposes, is to eliminate gas separation and provide straight gas from which the benzols have been removed.

Modern by-product coke oven engineering has not been content with the saving of 60 per cent of the total gas produced as surplus, but has found means to render the entire production of gas available for use outside the plant. This has been accomplished by the utilization of producer gas for heating the ovens. As will be noted later, blast furnace gas or other low-grade gases may be substituted for producer gas. In the use of such gases, preheating is essential, and the most economical means in combination with the by-product coke oven has been achieved in the Koppers combination oven. This oven may be heated either with producer gas or with coke oven gas and affords the maximum flexibility with respect to gas production. The combination oven is of especial importance from the standpoint of the natural gas interests. It is indispensable for any plant built primarily for the manufacture of gas and may soon even be considered indispensable to by-product coke plants affiliated with the iron and steel industry.

Gas Requirements of the Iron and Steel Industry

In any consideration of the by-product coke industry, we cannot neglect its intimate relation with the iron and steel industry, and this relation profoundly affects any estimates that may be made in connection with the utilization of coke oven gas. More than ninety per cent of the coke manufactured in the United States is used in iron and steel manufacture. Although it is true that many plants have been built altogether apart from iron and steel plants for the primary purpose of gas production, nevertheless under present conditions, most of these plants depend very largely upon blast furnaces and foundries for the bulk of their coke sales. The majority of the by-product coke plants are built in conjunction with the iron and steel works that they serve, and it is universally agreed that this close relation is to the best interests of the iron and steel industry. The availability of coke oven gas for various uses around the iron and steel works is one of the principal reasons why this is so.

During recent years, much thought has been given to the economic balancing of the fuels produced in iron and steel manufacture. It is generally agreed that a complete steel plant comprising blast furnaces, open hearth furnaces, rolling mills and by-product coke ovens will need all of its blast furnace gas and all of its surplus coke oven gas for its own use. In addition, the coke oven tar has been found to be excellently adapted for heating open hearth furnaces. In the case of merchant blast furnace plants manufacturing their own by-product coke, very little of the surplus coke oven gas is needed on the plant, and practically all may be sold.

What then are the prospects of obtaining coke oven gas from iron and steel plants operating their own by-product coke ovens?

1. As has been stated, practically all of the surplus coke oven gas from merchant furnace plants is available. To this may be added such additional coke oven gas as may be obtained by using producer or blast furnace gas for heating the ovens.

2. Considerable quantities of coke oven gas are wasted at steel plants during week-end shut downs. The amount of this depends upon local conditions and is very difficult to estimate; but in many cases this possible source of supply is worth investigating.

3. Steel plants using all their surplus coke oven gas may, under certain conditions, find inducement to use producer gas for heating the coke ovens, thus releasing considerable quantities of high-grade gas for sale.

Since it may be fairly assumed that all the surplus gas produced by coke ovens operating in conjunction with merchant furnaces is already being utilized, the question of obtaining further supplies of gas from existing installations is, therefore, narrowed down to the prospective relief that might be afforded by the substitution of producer gas for oven heating. We are at once confronted with the fact that no plant of by-product coke ovens operating as a part of an iron and steel plant, is now adapted to the economical utilization of producer gas. The combination oven is the only type that can use producer gas with the requisite degree of efficiency, and although the difference in structure between this and the ordinary Koppers coke oven is comparatively simple, no battery of coke ovens could be adapted for use as combination ovens without rebuilding. It is, therefore, to the interests of natural gas men, in looking to iron and steel industries for additional supplies of high-grade gas, to become acquainted with the merits of the combination oven and to impress the various iron and steel companies with the desirability or replacing their present ovens with combination ovens, whenever rebuilding is necessary, and of arranging their plans so that future extensions of existing plants will comprise combination ovens instead or ordinary coke ovens.

The use of combination ovens in plants built primarily for gas production is several years old, and these plants have already given convincing demonstrations of success; but the idea of building combination ovens for iron and steel plants is comparatively so recent, and the various arguments in relation to it are so important, that it is desirable to discuss the matter somewhat at length. In the first place, the use of producer gas for heating by-product coke ovens has a number of valuable operating advantages over the use of coke oven gas. These may be summed up in greater convenience of regulation and economy in labor. These operating advantages are important, but might not alone be sufficient incentive for the substitution of combination ovens. There are, however, a number of economic considerations that seem to prove that the adoption of the combination oven is desirable, either on account of present inducements, or for the sake of providing insurance against future developments.

Various Producer Gas Operations for Coke Oven Heating

In considering the economic operation of gas producers in connection with by-product coke ovens, several possibilities present themselves, and the variety of possibilities, when considered in the light of the potential economic advantages, is one of many arguments in favor of building every by-product coke plant so that producer gas may be used at any time for heating the ovens if desired.

This subject has been discussed at some length in a paper by Joseph Becker and F. W. Sperr, Jr., recently presented before the Blast Furnace and Coke Association of Chicago, and the principal arguments are taken from this paper.

First, the producers may be fed with small-sized coke unsuitable for use in the blast furnaces. Here the equipment is simple and comparatively inexpensive, especially with respect to the gas cleaning apparatus. The amount of coke required for the producers is 12 to 14 per cent of the weight of the coal charged into the ovens. This amount may readily be obtained by properly screening the oven product, leaving a high grade, thoroughly clean coke for the use of the blast furnaces.

Second, where there is available a cheap coal, having fair coking qualities, but unsuitable for the manufacture of blast furnace coke, such coal may be coked in some of the by-product ovens delivering, thereby, its by-products and furnishing sufficient coke for the operation of the gas producers.

Third, where there is available cheap low-grade coal unsuitable for making blast furnace coke, such material may be used directly in the gas producers.

Fourth, by-product producers may be installed using any coal available. The equipment and operation of by-product producers fits in very well with that of the by-product coke plant, and the combination, costing much less than separate plants, offers many possibilities for increased economy and valuable returns. Heretofore, on account of coal values, the employment of by-product gas producers has been more extensive in Europe than in America, and here, with the present appreciation of coal values, their development presents enormous possibilities.

The Kerpely Gas Producer

The type of producer conspicuous in European practice in connection with by-product coke ovens and elsewhere is the Kerpely producer. The Koppers Company controls the American patent rights on this type of producer and is actively adapting it to American conditions for its by-product coke oven operations and in connection with by-product producer plants. The next few years will witness much important progress along this line.

Economic Changes Favoring Coke Oven Gas

The situation is that, on the one hand, the developments of the gas producer, whether using coal or coke in connection with by-product coke ovens, together with the successful and advantageous application of producer gas to oven heating, are such as to offer the strongest inducements for this method of heating; while on the other hand, the demand for high-grade gas is increasing so that every by-product coke plant in the country is, sooner or later, going to be required to render available every cubic foot of coal gas that it makes.

It is eventually going to be considered rank inefficiency for any plant to use this valuable gas for the purpose of heating its ovens, which purpose could even be better served by lower-grade gas. These requirements are going to be brought about by the increasing shortage and cost of good coal, the increasing shortage of natural gas and fuel oil, and by the advantages of coke oven gas over lower-grade gases from the various standpoints discussed. In the face of this, it is plain that every new battery of by-product coke ovens built in connection with a steel plant or blast furnace ought to have provisions so that, at any time, producer gas equipment can be added to the plant and so that the ovens can be heated either with this gas or with blast furnace gas.

The Combination Oven and Its Relation to Future Developments

Suppose that, in the case of a given projected plant, it might possibly appear, on the face of present financial returns, that there would be no marked present gain from the installation of gas producers in connection with the coke ovens. Nevertheless, assuming that the life of a battery of modern coke ovens is from ten to fifteen years, and in view of the great economic and engineering progress possible in the life of such a plant, one should hesitate to commit himself to building plain coke ovens, which would practically require rebuilding before they could use producer gas economically. The use of producer gas or blast furnace gas might well be advantageous a few years hence, if not now. The building of combination ovens is, in effect, providing insurance against future contingencies at relatively low cost and with promise of large returns.

As a further consideration, it should be pointed out that the combination oven can be heated with blast furnace gas as well as with prdoucer gas, and under certain conditions, this method of heating has the advantage of requiring very small expense for equipment to release large quantities of high-grade coke oven gas.

Geographical Considerations

It is a striking fact that the great majority of by-product coke plants have a most fortunate location, with respect to advantageous disposal of the gas that they produce. The locations, too, are remarkably fortunate when considered in connection with natural gas interests.

At present, there are very nearly 11,000 by-product coke ovens in active operation, or approaching completion, in the United States. These ovens have an estimated maximum capacity of about 66,000,000 tons of coal per year. Eighty-seven per cent of the present by-product coking capacity in this country is comprised within seven great industrial districts named. Thirty-five per cent of this capacity is located in the Cleveland-Pittsburgh district, which is also the largest natural gas consuming district. The total amount of by-product coke oven gas manufactured in this district is considerably more than the annual production of natural gas in the State of Pennsylvania. Of the seven districts, five (omitting the eastern Pennsylvania and Birmingham districts), are, or have been in the past, important consumers of natural gas.

It is of interest to estimate how much of the by-product coke oven gas produced in these important districts is used for heating the ovens. All of the ovens listed are now being heated with coke oven gas. Taking 80 per cent as a factor for normal working conditions we have an estimated production of 408,000,000,000 cu. ft. of gas. On account of the fact that many of the oven installations are of old design and relatively inefficient in heating, at least half of this gas is being used for coking purposes, so that over 200,000,000,000 cu. ft. of gas per year could be released, if the plants had combination ovens operated with producer gas. This is about equivalent to the combined natural gas production of Pennsylvania and Ohio. It is 38 per cent of the entire amount of natural gas consumed east of the Mississippi River.

It is important to note further that the future growth of the by-product coke industry will naturally be in the great gas consuming districts. Much of it will still be in the seven districts mentioned. It has been estimated that the blast furnaces in Ohio and Pennsylvania, at present, have a normal consumption of nearly 45,000 tons of beehive coke per day. If this coke were made in by-product ovens it would entail the use of 22,000,000 tons of coal per year, and there would be recovered a total of 231,000,000,000 cu. ft. of gas per year. Sixty per cent of this, or 138,600,000,000 cu. ft. would at once be available and, although a great deal of this would be consumed in the various steel plants, it would nevertheless contribute its equivalent toward the conservation of natural gas and oil, because in many cases it would be used to supplement or replace these fuels, thus releasing equivalent quantities for use elsewhere. If combination ovens are built, the entire amount can be rendered available when the demands of gas consumers so require. Here again a study of the whole situation will show that the building of combination ovens is of very great importance, and the interests most concerned, of which the natural gas industry is one, should use every influence to bring this about.

By-Product Coke Plants for Gas Manufacture Independent of Iron and Steel Plants

The growth of the by-product coke industry independent of the iron and steel industry and the prospects for developing it primarily as a source of gas without necessity for relying on the needs of blast furnaces, depend almost entirely on the question of coke disposal. The extension of the domestic coke market is of great importance in this connection, and much progress has recently been made in this direction. The situation bears close relation to the condition of anthracite coal supply, which is yearly becoming poorer in quality and more inadequate in amount. Just as the availability of natural gas has accustomed millions of American people to the use of gas fuel for domestic purposes, so the wholesale use of anthracite coal as domestic fuel has paved the way to the introduction and substitution of coke.

The best type of plant for the manufacture of gas and domestic coke is one of combination ovens with gas producers. Such a plant possesses the flexibility requisite to meet the varying demands of gas consumers. The output of gas for sale may be increased or decreased four or five hundred per cent, according as the ovens are operated with producer gas at their maximum coking time, or as they are heated with coke oven gas at a very slow rate of coking. The producers may be operated either with coal or with coke, as has been described in previous paragraph.

As the demands of the natural gas industry for a supplementary supply of high-grade artificial gas outgrow the possibilities afforded by such by-product coke plants in any locality, it is certain that additional by-product coke plants will be erected primarily to meet the needs of the natural gas industry. The choice of location of such plants will, in many cases, be quite different from that which has been found advantageous in the case of plants hitherto constructed. It has been pointed out that the proper location for by-produc ovens operating in connection with iron and steel plants that need the coke oven gas, is in close proximity to the plants that they serve. The main considerations governing the location of coke ovens built to supply coke to merchant blast furnaces, or to supply gas to cities, are the price and disposition of the gas and the freight rates on the coal used and the coke produced. The choice in this case is usually a compromise between cost of freight and price obtainable for gas, together with accessibility to the points of consumption of the gas. Much might be saved if it were possible to build the by-product coke ovens at the coal mines, as has been the general practice in the case of beehive ovens; but this has hitherto seldom been permissible, either because the mines were located too far from the consumers of gas, or because the locations were in districts well supplied with natural gas. With diminishing natural gas supply, the peculiar relations of the natural gas industry with respect to the coal mining regions of Pennsylvania, Ohio and West Virginia are likely to make it profitable to build by-product coke ovens at the mines, because many coal mines supplying good coking coal are within easy reach of large natural gas distributing systems into which the coke oven gas could readily be conveyed. With a reasonable price for the gas and with proper methods of coke disposal, such plants can operate with maximum economy. The low price of land at the mines is an important item in this connection.

Manufacture of Mixed Gases

It is the opinion of many economists who have studied the problems of conservation and efficient utilization of our fuel resources that the ultimate ideal should be the conversion of all the coke into gas at the by-product coke plant, so that the plant will supply all of its fuel product in gaseous form. It may be that we are in a transition period that will ultimately end in discontinuing entirely the use of solid fuel for most industrial and for all domestic purposes. This would mean that there would ultimately be no domestic coke problem, but it must be recognized that any such transition period is bound to be a long one, and that while we are passing through it, the use of domestic coke must be extended and encouraged.

Progress toward the general use of gas as sole domestic fuel must necessarily be slow and depends largely on accustoming people to lower heat value standards. There can be no question that at present, from an economic standpoint, we are working on too high a level as regards the heating value of gas. Until people and public authorities generally are convinced that it will pay them better to allow their gas companies to serve

them with gas of lower heating value, with a fairly adjusted compensation for the same, plants will have to be built to furnish gas of the high quality demanded. Those plants which are operated independently of an assured industrial coke market, such as that afforded by the iron and steel industry, must meet and solve the question of coke disposal.

The failure of natural gas supply first manifests itself in a scarcity in winter-time peak loads for house heating. It is becoming increasingly manifest that domestic consumers will be forced to meet these periods of scarcity by the use of auxiliary heating equipment burning solid fuel. This solid fuel demand will give the by-product coke plant an outlet for considerable domestic coke.

The proposition of gasifying all of the coke produced at the by-product coke plants leads to the subject of mixed gases, because all of the surplus gas produced from the coke over and above the requirements of the plant for its own steam, power, and heating, will, in the majority of cases, be mixed with the coke oven gas before distribution to the consumer. This subject is one of great importance. It has such a wide scope and involves so many subsidiary questions, both economic and technical, that it cannot be adequately treated within the limits of this paper. Attention will, however, be directed to a few leading points.

1. The mixed gas sold to the consumer must have such characteristics with respect to specific gravity and heating value as to meet his purposes satisfactorily without unduly increasing the investment required for his appliances.

2. The question of the rate of heating afforded by the gas is in many cases more important than the total heat units supplied. The rate of heating is, of course, a function of the flame temperature. For example, straight producer gas has been burned in cook stoves, but its flame temperature is so low that it works much too slowly to be practicable.

3. It is very questionable whether it ultimately pays to sell gas containing a large percentage of inert, incombustible constituents for wide distribution. The principle involved is much the same as in the transportation of coal containing high percentages of ash.

4. There are two generally feasible methods for the production of mixed gas at the by-product coke plant with complete gasification of the coke, viz.:

(A) Gasification of the coke in producers using part of the producer gas to heat the ovens and the remainder to mix with the coke oven gas. This method would produce per ton of coal over and above plant requirements, 10,500 cu. ft. coke oven gas of 560 B.t.u. and 75,600 cu. ft. of producer gas of 130 B.t.u., making 86,100 cu. ft. mixed gas of 183 B.t.u.

(B) Part of the coke is gasified in producers making sufficient gas to heat the ovens. The remainder of the coke is put into water gas generators and its carbon converted into blue water gas which is mixed with the coke oven gas. This method will produce per ton of coal 10,500 cu. ft. coke oven gas at 560 B.t.u. and 22,600 cu. ft. blue water gas of 300 B.t.u., making 33,100 cu. ft. mixed gas of 383 B.t.u.

The second method described produces a mixed gas of a heating value that is satisfactory for all domestic purposes. The mixed gas produced by the first method is capable of wide industrial application, but the possibilities of utilizing it for domestic purposes have not yet been developed.

A typical plant of combination oven that has for some time been operated with producer gas is that of the Providence Gas Company, Providence, R. I. This plant has forty ovens which taper from 18½ in. in width at the discharge end to 15¾ in. at the pusher end, are 9 ft. 10 in. high and 37 ft. long (inside dimensions) and have a rated capacity of 11.4 tons coal per charge. Experience with the use of producer gas at this plant has demonstrated a number of advantages over the use of coke oven gas that should be briefly described here. It should be borne in mind that with coke oven gas we are dealing with a fuel containing high percentages of hydrogen and hydrocarbons and capable of intense local overheating unless the conditions of combustions are carefully regulated. Furthermore, unless proper precautions are taken, there is a tendency for some of the hydrocarbons to be decomposed or "cracked" by the heat, which causes accumulation of carbon and occasional stoppages in the gas distributing systems.

With producer gas firing, on account of the absence of hydrocarbons, there is no accumulation of carbon in the gas distributing system. Practically no attention need be given to gas pipes and flues which means economy in labor. The flue temperatures are easily adjusted and remarkably uniform. There is less possibility of localized overheating. With producer gas we are dealing with a fuel that is handled in relatively larger volumes than is the case with coke oven gas and no such fine adjustments are necessary with the former as with the latter. Furthermore, any slight irregularities in the rate of gas flow, in the way of adjustment, or in the height of flame, make much less difference in the coke temperature than would result from similar irregularities in the case of coke oven gas. With producer gas it is a much simpler matter to maintain efficient and uniform heating with a low percentage of excess air than when using coke oven gas. At Providence, the analysis of the products of combustion showed 17 to 18 per cent carbon dioxide with about 1 per cent of oxygen and practically no carbon monoxide. Such a close approximation to theoretically perfect conditions of combustion combined with uniform heating is a remarkable achievement in the use of producer gas. At fourteen hours coking time the temperature of the stack gases was about 350 deg. Cent.

Rapid Coking with Producer Gas

All of these operating results and advantages have been demonstrated at the Providence plant. The use of producer gas has been found to be excellently adapted to the maintenance of very short coking times, where absolute uniformity of temperature is of the utmost importance. The ovens were operated with straight producer gas at fourteen hours coking time for a test period of two weeks and were operated at fourteen and a half hours coking time for a period of four weeks. It was demonstrated that such rates of coking would be maintained regularly and without extra attention. The fourteen hours coking time corresponds to a rate of carbonization of one inch oven width at the wide end in 45.4 minutes.

Providence Gas Co. Allowed Increased Rates, Including $6 Service Charge

The Public Utilities Commission has denied the petition of the Providence (R. I.) City Council to suspend the proposed increase of rates of the Providence Gas Company pending an investigation. The rate increase will become effective from May 17 and all gas billed to the consumers after that date will be at the new rates.

The schedule was filed April 24, to become effective May 17, and City Solicitor Elmer S. Chace appeared before the commission in behalf of the city to urge suspension pending hearing next month on the merits of the case.

Chairman Bliss of the utilities commission in denying the suspension of the increase said:

"I believe that it is the duty of this commission to conserve this company's rights just as much as the public's rights. The complainant has urged its particular objection to the application of the service charge principle in the proposed rate schedule.

"The respondent company has for a period of nearly two months taken up the matter of the new schedule with the complainant through its joint committee on lights and its manufacturing costs, and all data were fully submitted to that committee. A full investigation of the emergency conditions confronting the company with reference to its future supply of gas oil has been made by the committee and the public service engineer of the complainant.

"A unanimous report has been made by said joint committee on lights to the complainant city council, expressing the conviction that conditions at the present time do warrant the assent of the city council of Providence to the pending schedules.

"The respondent company paid a 4 per cent dividend for the year 1919, not wholly earned, and failed to make its normal and proper allowance for depreciation.

"The commission has made a preliminary investigation into the manufacturing costs of the respondent company, and the conditions confronting the company with reference to its future supply of gas oil.

"After investigation, hearing testimony of witnesses and argument of counsel, the commission are of the opinion that the motion of complaint should be and the same is hereby denied."

Large Attendance at Natural Gas Association Convention

Senator Edge Speaks on Relation of Government to Business—U. S. Bureau of Mines Exhibit Feature of Exposition

The fifteenth annual convention of the Natural Gas Association of America was held at Buffalo, N. Y., May 17 to 20 inclusive. Bert C. Oliphant, president of the Iroquois Natural Gas Company and president of the Natural Gas Association, opened the convention and presided at every session. The following officers were elected for the ensuing year: James H. Hoover, of Cincinnati, President; L. B. Denning, O. K. Shannon, N. A. Quay, vice-presidents, and W. B. Way was re-elected secretary and treasurer.

Many interesting papers were read by men prominent in both the artificial and the natural gas fields, including "Service and Conservation Under the Three-Part Rate," by Henry L. Doherty; "The Gas Company's Opportunity in the Appliance Department," by I. Lundgaard; "Present Known Eastern Gas Fields and Their Probable Life," by W. I. Moyer; "The By-Product Coke Oven in Relation to Natural Gas Supply," by C. J. Ramsburg; "Federal Taxation of Gas Wells," by Roswell H. Johnson, and "Radiant Heat," by J. P. Conroy.

One of the principal features of the convention was the exhibition of the U. S. Bureau of Mines. Education in the application of methods which tend to the saving of natural gas was the prime motive for this exhibit. Nearly 100 manufacturers had exhibits among which that of the Humphrey Company, of Kalamazoo, Mich., stood out as being unusually attractive.

It consisted of a 5R Humphrey double copper coil tank heater with full blue porcelain enamelled jacket, one No. 5-I double copper coil tank heater with black japan cast iron shell, and also one each of the No. 4A and 30 Humphrey automatic water heaters, hooked up to an attractive lavatory for demonstration in operation.

Among the other exhibitors were Metric Metal Works, Erie, Pa.; Ludlow Valve Manufacturing Company, Troy N. Y.; Pittsburgh Meter Company, Pittsburgh, Pa.; Sprague Meter Company, Bridgeport, Conn.; Welsbach Company, Gloucester, N. J.; Hoffman Heater Company, Lorain, Ohio; General Gas Light Company, Kalamazoo, Mich.; Chaplin-Fulton Company, Pittsburgh, Pa.; Equitable Meter Company, Pittsburgh, Pa.; Koppers Company, Pittsburgh, Pa.; Ruud Manufacturing Company, Pittsburgh, Pa., and Clarke Bros, Chicago, Ill.

A tubular steel drilling derrick was erected on Lafayette Square by permission of John F. Malone, Commissioner of Parks and Public Buildings of Buffalo. Upon this was hung a large sign announcing the exhibits at the Auditorium as being open to the public. It was an exceedingly effective affair, and really formed a monument to the gas men, as it were, welcoming them to the city.

There was a luncheon each noontime, Monday, Tuesday and Wednesday, as courtesy of the gas men by the supply men, both supply men and gas men being the privileged parties.

The annual banquet was held in Elmwood Music Hall Wednesday evening at six o'clock, about 900 being present. The speaker of the evening was U. S. Senator Walter E. Edge, who was former governor of New Jersey. L. B. Denning, of Pittsburgh, was toastmaster.

There was a large attendance and a very large addition to the membership roll.

Contracts Awarded

The Oxweld Acetylene Company, of Newark and Chicago, has been recently awarded the Government contract for cutting 4,000 tons of armor plate scrap to charging box size at Sandy Hook and now has a crew of oxy-acetylene cutters on the job. The plates, 3 inches thick by about 9 by 13 ft., weigh between 7 and 8 tons each, and are being cut into sections 13 by 25 in., each weighing around 300 pounds. The weights vary somewhat owing to the necessity for cutting through the shell holes, each plate having been punctured six times by heavy artillery shells for which they were made the targets in the big gun tests conducted at Sandy Hook during the war.

This is one of the largest jobs of the kind that has ever been undertaken and was awarded to Oxweld

in a competitive bid. Several weeks will be necessary to complete the work.

THE PEOPLE'S GAS COMPANY has entered into a contract with the Public Construction Company of Minneapolis to install a gas plant and a system of mains in the city of Marshfield, Wis. The figures of the company's bid are $76,200.

Construction work is to be started as soon as possible. The contractors aim to have the plant ready for operation by November 1 next.

It was stated that the system consists of 8¼ miles of mains.

THE J. G. WHITE ENGINEERING CORPORATION has been awarded the contract for the construction of the new wireless station to be built by the Radio Corporation at Rocky Point, L. I. Work will be begun immediately.

The station when completed will have a diameter of more than three miles with twelve sets of antennae, strung to seventy-two self-supporting steel towers 400 ft. high, set up a mile and a half away from the central power house, and will probably cost about $10,000,000. It will be divided into five units for communication with Argentina, France, Scandinavia, Germany and one with Italy and Poland.

THE GAS MACHINERY COMPANY, of Cleveland, Ohio, has a contract for the construction of the Wallace retorts for the Shale Oil & Refining Company and work on these large plants is now under way. It is stated that the contract is for equipment costing $282,000 and consists of 900 tons of material. When completed it is expected that the plant will have a capacity of not less than 400 tons of shale daily. It is expected that these retorts will be in operation before the end of the coming summer.

THE CADILLAC GAS COMPANY, Cadillac, Mich., won its fight for $1.80 gas rate after officials of the company had issued an ultimatum to the city commission that no more coal would be sent here until the raise was authorized.

THE BROOKLYN UNION GAS COMPANY, in its annual report to the Public Service Commission, shows a deficit of $706,848 for the year ended Dec. 31, as compared with a surplus of $199,791, or $1.11 a share, in the preceding year.

Personal Notes

Geo. E. Long, Vice-President of Joseph Dixon Crucible Company, Resigns

On April 19, following his re-election as a member of the Board of Directors at the annual meeting of the stockholders of the Joseph Dixon Crucible Company, Jersey City, N. J., George E. Long announced his decision to retire from the office of vice-president. Thereby he terminates forty-three years of active and valuable service with this company, beginning in the capacity of a stenographer and advancing to the offices of secretary, treasurer and vice-president, respectively.

It would be difficult to enumerate in detail the contributions that Mr. Long has made toward the wonderful growth of the Dixon Company's business during his service of forty-three years. In a much wider sphere than the Dixon family circle, Mr. Long is recognized as the "Daddy" of graphite lubrication, and as the "Father" of the silica-graphite paint for protective purposes. Similarly in advertising circles he has been recognized for many years, as he has been an ardent advocate at all times of ample publicity or advertising to inform possible users of the Dixon products in their wide variety. But, as already indicated, these specific items can only suggest Mr. Long's wide usefulness during his period of service.

CHESTER C. COLLINS, chief clerk in the office of the Western United Gas & Electric Company, Elgin, Ill., has been promoted to district manager of the Elgin-McHenry district, to succeed C. B. Strohn, who was recently elected vice-president of the company, and will make his home in Aurora.

Mr. Collins started with the gas company as a boy doing odd jobs after school. When he had completed the high school course he went into the office, where he remained until transferred to the office of the company's coal mines at Ethel, West Virginia.

He was in West Virginia when the war broke out and went into service from that place, finally winning a commission. Upon his discharge from the army last summer, he re-entered the service of the gas company as chief clerk in Elgin. His promotion comes from faithful, efficient service.

New Proposals Submitted in Texas Gas Controversy

Two alternate propositions, the original proposition of the majority of the board of commissioners of Dallas, Tex., with modifications, under which the increase in rate would become effective only when an adequate supply of gas is delivered and a new proposal allowing the increase in rate to become effective when the commitments of the Lone Star Gas Company have been fulfilled, but penalizing the Dallas Gas Company by a reduced rate on a sliding scale when the pressure falls below a fixed minimum, have been offered the gas companies.

The new proposition, which is the idea of Commissioner McGee he gained from investigations conducted on his recent trip to Pittsburgh, where he attended the meeting of the National Committee on Natural Gas Conservation, has been worked out successfully in Oklahoma.

Mr. McGee said he was willing that the increased rate should be paid so long as the supply of gas was sufficient and adequate, but when the pressure falls below a fixed minimum whereby enough gas is not furnished for ordinary cooking and heating the rate would be reduced on a sliding scale and might drop as low as 30 cents a thousand cubic feet.

In speaking of the new proposals of the city Henry C. Morris, general manager of the Dallas Gas Company, said that the plan for the reduced price at low pressure was not practical, as it would defeat its purpose by increasing consumption when conservation was needed. If the pressure should go below the minimum and the rate consequently reduced, many consumers would take advantage of the bargain prices and increase consumption.

Nine-tenths of the gas supplied Dallas is bought at the wells for a fixed price, irrespective of the amount of gas supplies, and should the price be reduced here every time the pressure becomes low it would work untold hardship upon the Dallas Gas Company, which would derive little benefit from the increased rate.

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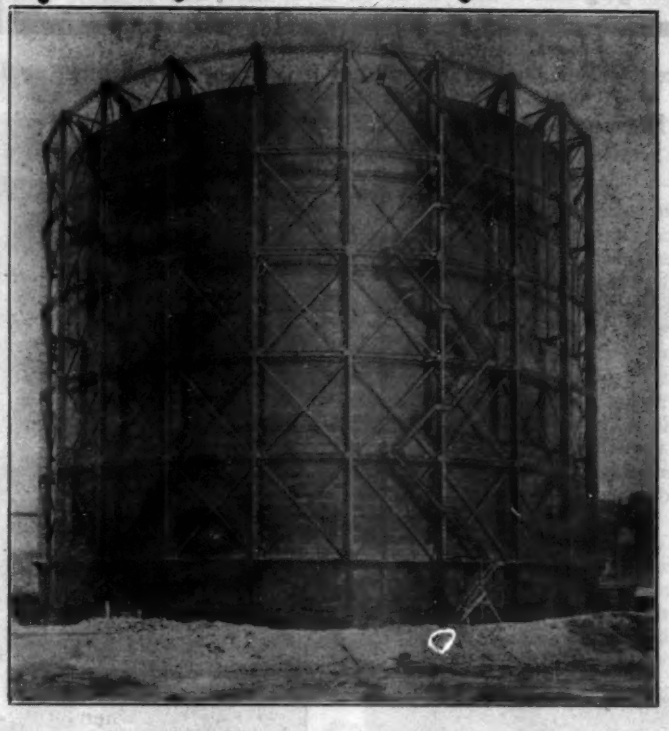

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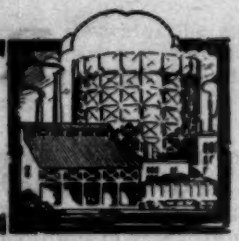

Conducted by Business Department of American Gas Engineering Journal

Larger Connection Between Water Gas Set and Relief Holder

The Western Gas Construction Company, Fort Wayne, Ind., has hit upon a unique and successful plan to relieve conditions which are arising in gas plants all over the country—namely, where the producers of carburetted water gas find that the demand for their product has outgrown the size of their yard piping and that they must provide a larger connection between the water gas set and the relief holder in order to reduce the back pressure on the water gas set.

While, formerly, such a connection had to be made at great expense by establishing an underground connection and shutting off the use of the holder for a considerable period, it is now possible to make an overhead connection without putting the holder out of commission.

The cuts of this new so-called "Grasshopper" connection, showing one in use at the plant of the Lancaster Gas Light & Fuel Company, Lancaster, Pa., and the other at the plant of the Union Gas & Electric Company, Bloomington, Ill., tell the story of the advantage of this plan, both of which have been in

actual use for two years.

The use of a counterbalance and a vertical, hinged leg, serves to remove all vertical and horizontal loads from the holder crown, and the finished holder operates as freely as it did before it was fitted with the additional outlet.

The design and installation of the connections shown in the two cuts were under the personal supervision of A. C. Howard, gas engineer of the United States & Electric Engineering Company, of New York, who writes concerning the installation that "it may interest you to know that these connections can be made without emptying the relief holder," and thus avoid the expense and inconvenience of shutting down any department of a gas plant.

The use of a large inlet connection to a relief holder in a water gas plant means oil saved and money saved, and the "grasshopper" connection, according to the engineers and the manufacturers, provides the solution without the expensive process of excavating and installing a new gas connection under an existing water tank.

Conditions in many plants producing carburetted water gas would seem to open a wide demand for these "grasshopper" connections.